

# Wheeler-Feynman Absorber Theory Viewed by Model of Expansive Nondecelerative Universe

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**Abstract.** The present contribution documents the harmony of postulates and conclusions of Wheeler-Feynman absorber theory and the model of Expansive Nondecelerative Universe. A relationship connecting advanced electromagnetic waves and gravitational field quanta is rationalized.

## Advanced and retarded waves in absorber theory

The absorber theory was developed by Wheeler and Feynman in the forties [1] and elaborated by many others [2]. One of the features of modern physics is a renaissance of the above theory, its postulates, predictions, and consequences. The theory was aimed at the rationalization of radiation resistance.

During its accelerated motion a charged particle – a source of radiation - emits electromagnetic waves. These waves, known as classic retarded waves, are absorbed by another charged particle – absorber - that, in turn, produces both retarded and advanced waves, the latter being characterized by negative energy. Advanced waves move backward in time to the emitter (instantaneous effect) and may act as a bearer of information.

Evaluating the problem in more detail from the viewpoint of mathematics, differential equation describing the propagation of an emitted wave is second order in both space and time and provides thus two independent time solutions and two independent space solutions. It follows from a time-symmetrical solution of Maxwell equations [2]

$$\nabla \times E_{\pm} = -\frac{dB_{\pm}}{dt} \quad (1)$$

that as to the vector of electric field intensity  $E_+$ , negative energy is attributed to the advanced waves, and as to the vector  $E_-$ , positive energy relates to the retarded waves. Denoting the electric field vector  $E$  (or the

magnetic field vector  $B$ ) of the wave as  $F$ , then the retarded and advanced waves can be defined by the following equations [2]

$$F_{ret} = -i.F_0.\exp[i(k.r - \omega.t)] \quad (2)$$

$$F_{adv} = i.F_0.\exp[i(-k.r + \omega.t)] \quad (3)$$

where  $k$  is the propagation vector,  $r$  is the distance from the source of radiation,  $\omega$  is the frequency of the wave, and  $t$  is the time. It follows from (2) and (3) that the retarded wave represents the positive-energy solution and reaches a point at the distance  $r$  after the instant of radiation emission. Contrary, the advanced wave is the negative-energy (and negative frequency) solution and comes to a point at the distance  $r$  before the instant of radiation emission.

Wheeler-Feynman absorber theory can be understood as an alternative to the classic probability interpretation of the Copenhagen school. It can contribute to explanation of several known paradoxes, such as that of Schrödinger cat, quantum mechanical Einstein-Podolsky-Rosen locality premise, experiment with two slits, etc. [3, 4].

## Gravitation in Expansive Nondecelerative Universe

In the Expansive Nondecelerative Universe (ENU) model [5-7], negative values are attributed to the quanta of gravitational field, i.e. such quanta might represent a good candidate for advanced waves. Gravitational output  $P_g$  of a body with the mass  $m$  is defined in the ENU as follows

$$P_g = -\frac{d}{dt} \int \frac{R.c^4}{8\pi.G} dV = -\frac{m.c^3}{a} \quad (4)$$

where  $a$  is the gauge factor of the Universe (its present calculated value is  $1.3 \times 10^{26}$  m) and  $R$  is the scalar curvature (contrary to a more frequently used Schwarzschild metric in which  $R = 0$ , in Vaidya metric applied in the ENU,  $R \neq 0$  also outside a body).

The wave function of gravitational quanta is in the ENU described as

$$\Psi_g = \exp \left[ i.t. \left( \frac{m.c^5}{\hbar.a.r^2} \right)^{1/4} \right] \quad (5)$$

In order to preserve the consistency of our postulates, it must hold

$$\alpha.P_e = |P_g| \quad (6)$$

where  $\alpha$  is the fine structure constant and  $P_e$  is the electromagnetic (radiative) output of an accelerated charged particle. It follows from (4), (5), and (6) that

$$\Psi_g = \exp \left[ i.t. \left( \frac{\alpha.P_e.c^2}{\hbar.r^2} \right)^{1/4} \right] \quad (7)$$

### Gravitational quanta and advanced waves

Postulating that the emitter must interact with more than one charged particles, the mass  $m$  in (4) represents a total mass of all charged particles interacting with the emitter during its accelerated orbital motion. In (5) and (7),  $r$  is the mean distance of the emitter from the above mass of absorbers and, at the same time, it represents a mean radius of the emitter orbit curvature at its motion. Further, a Schrödinger-type relation must hold

$$i.\hbar.\frac{d\Psi_g}{dt} = E_g.\Psi_g \quad (8)$$

Stemming from (7) and (8) it follows that

$$|E_g| = \left( \frac{\alpha.P_e.c^2.\hbar^3}{r^2} \right)^{1/4} \quad (9)$$

where the radiation output  $P_e$  of a charged emitter moving with the acceleration  $g$  is formulated as

$$P_e = \frac{e^2.g^2}{6\pi.\varepsilon_o.c^3} \cong \frac{\alpha.\hbar.g^2}{c^2} \quad (10)$$

Based on (9) and (10) it holds

$$|E_g| \cong \hbar \left( \frac{\alpha.g}{r} \right)^{1/2} \quad (11)$$

Simultaneously,  $E_g$  must be identical to the energy  $E_{adv}$  of advanced waves

$$E_g = E_{adv} \quad (12)$$

For synchrotronic radiation the rate  $v$  of particles approach the rate of light  $c$

$$v \cong c \quad (13)$$

and acceleration is nearly

$$g \cong \frac{c^2}{r} \quad (14)$$

In such a limiting case the advanced and retarded waves can be described by functions

$$\Psi_{adv} = \exp \left[ i.t. \left( \frac{\alpha.g}{r} \right)^{1/2} \right] \quad (15)$$

$$\Psi_{ret} = \exp \left[ -i.t. \left( \frac{\alpha^{1/2}.g}{c} \right) \right] \quad (16)$$

Using (13) and (14) the following equality can be evidenced

$$E_g = E_{adv} = -E_{ret} \quad (17)$$

## Conclusion

A target of the present contribution does not lie in evaluation of the correctness of Wheeler-Feynman absorber theory. Based on the validity of a logic assumption (6), it is rather aimed at offering gravitational field quanta as a suitable candidate of advanced waves.

## References

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